What is claimed is:

1. A method of processing fullerenes comprising the steps of:

generating a gas stream comprising suspended soot particles and condensable gases, said condensable gases comprising gaseous fullerenes, and

separating at least a portion of the condensable gases from the suspended soot particles using a gas/solid separations process,

wherein said gaseous fullerenes are not condensed prior to separation.

2. The method of claim 1, wherein the gas stream of suspended soot particles and condensable gases is obtained using a method selected from the group consisting of combustion, arc plasma discharge, laser ablation, graphite burning, and negative ion/desorption chemical ionization.

3. The method of claim 1, wherein the gas stream of suspended soot particles and condensable gases is obtained using a combustion device.

4. The method of claim 1, wherein the separations process is conducted under conditions of optimal fullerene stability.

5. The method of claim 4, wherein conditions of optimal fullerene stability comprise conditions where consumption of fullerenes by soot particles or other species contained in the gas stream is minimized.

6. The method of claim 5, wherein the time-scale of gas/solid separation is small relative to the time-scale of fullerene consumption.

7. The method of claim 1, wherein fullerenes having a volatility lower than a selected volatility are separated with the suspended soot particles in the gas/solid separations process.

8. The method of claim 1, wherein the gas stream has a residence time of between about 10 msec and about 10 sec upstream of the separations process prior to separation.

9. The method of claim 1, wherein the gas stream has a residence time of between about 100 msec and about 2 sec upstream of the separations process prior to separation.

10. The method of claim 1, wherein the portion of condensable gases separated from the suspended soot particles is enhanced in selected fullerene species to a greater extent than other fullerene species.

11. The method of claim 1, wherein the gas/solid separations process is a concentrator, producing a higher percentage gas effluent stream with respect to suspended soot, and a lower percentage gas effluent stream with respect to suspended soot.

12. The method of claim 1, wherein the separation of at least a portion of the condensable gases from the soot particles is accomplished at a temperature of less than about 1100 °C.

13. The method of claim 1, wherein the separation of at least a portion of the condensable gases from the soot particles is accomplished at a temperature in the range of about 300 °C to about 2000 °C.

14. The method of claim 1, wherein the separation of at least a portion of the condensable gases from the soot particles is accomplished at a temperature in the range of about 300 °C to about 900 °C.

15. The method of claim 1, further comprising:

condensing at least a portion of the fullerenes in the condensable gases after separation of the condensable gases.

16. The method of claim 15, wherein the condensed fullerenes form as suspended particles.

17. The method of claim 16, wherein the fullerenes condense by heterogeneous nucleation and/or homogeneous nucleation, in the gas stream which contains suspended seed particles.

18. The method of claim 15, wherein nucleation and/or growth of particles is promoted by sonic, ionic, or radioactive methods.

19. The method of claim 17, wherein said seed particles comprise soot.

20. The method of claim 15, further comprising:

collecting the condensed fullerenes in a separations process.

21. The method of claim 20, wherein the separations process comprises a gas/solid separations process.

22. The method of claim 1 or 21, wherein the gas/solids separations process is selected from the group consisting of filtration, electrostatic precipitation, electrostatic separation, and inertial separation.

23. The method of claim 22, wherein filtration is selected from the group consisting of sieve filtration, fiber filtration and packed bed filtration.

24. The method of claim 20, wherein collecting comprises condensing the fullerenes onto a surface.

25. The method of claim 16, wherein the mean size of particles formed downstream of the gas/solid separation device is in the range of 0.1 μm to 500 μm.

26. The method of claim 16, wherein the mean size of particles formed downstream of the gas/solid separation device is in the range of 10 μm to 200 μm.

27. The method of claim 20, wherein the velocity of the gas stream is maintained at a velocity selected to minimize losses of fullerenes to surfaces during conveyance of the gas stream to a collection site.

28. The method of claim 1 or 15, wherein a diluent gas is added to the gas stream.

29. The method of claim 15, wherein the step of condensing comprises condensing first selected fullerene species or set of fullerene species.

30. The method of claim 1, further comprising:

collecting the first condensed fullerene species or set of fullerene species in a separations process.

31. The method of claim 1, wherein the separations process is a gas/solid separations process.

32. The method of claim 1, further comprising:

condensing a second selected fullerene species or set of fullerene species after condensation of the first selected fullerene species or set of fullerene species.

33. The method of claim 32, further comprising:

collecting the condensed second fullerene species or set of fullerene species in a subsequent separations process.

34. The method of claim 33, wherein the separations process is a gas/solid separations process.

35. The method of claim 15, wherein the temperature of the gas stream is in the range of about minus 250° C to 1200° C.

36. The method of claim 15, wherein the temperature of the gas stream is in the range of about 100° C to 800° C.

37. The method of claim 1, wherein conditions are maintained in a reaction zone downstream of the gas/solid separations process to promote additional fullerene formation in the gas stream.

38. The method of claim 37, wherein a second gas/solid separation process is carried out after the formation of fullerenes in the reaction zone to separate at least suspended soot formed as a by-product of the additional fullerene formation.

39. The method of claim 37, wherein temperatures downstream of the gas/solid separations process are maintained at about 500° C to 2200° C.

40. The method of claim 37, wherein temperatures downstream of the gas/solid separations process are maintained at about 900° C to 1700° C.

41. The method of claim 20, wherein condensation and collection of non-fullerene condensable species is accomplished subsequent to collection of the fullerene species.

42. The method of claim 41 wherein the non-fullerene species comprises polycyclic aromatic hydrocarbons.

43. The method of claim 38, further comprising:

condensing at least a portion of the fullerenes from the condensable gases after the second gas/solid separations process; and

collecting the condensed fullerenes in a separations process.

44. The method of claim 1 or 20, wherein the gas/solids separation device is operated in a steady mode.

45. The method of claim 1 or 20, wherein the gas/solids separation device is operated in an un-steady mode.

46. The method of claim 15, 30, 32 or 37, wherein the percentage by weight of fullerenes to soot and other condensables in the collected condensed fullerenes is in the range of about 70% to 100%.

47. The method of claim 20, wherein the collected condensed fullerenes are enriched in fullerenes as compared to the fullerene content of the gas stream prior to separation of the suspended soot from the gas stream.

48. The method of claim 15, wherein the collected condensed fullerenes comprise about 10% to about 70% by weight fullerenes.

49. The method of claim 1 or 15, wherein temperature of the gas stream is controlled by use of conductively cooled surfaces, and/or inert gases, and/or heat absorption by phase change.

50. The method claim 1 or 20, wherein residence time in the gas/solids separation process is controlled by addition of an inert gas.

51. A method for processing fullerenes comprising the steps of:

burning a carbon-containing fuel under conditions effective to produce fullerenes and to generate an effluent gas comprising suspended soot particles and condensable gases, said condensable gases comprising fullerenes; and

separating at least a portion of the condensable gases from the suspended soot particles using a gas/solid separations process.

52. The method of claim 51, wherein the separation of at least a portion of the condensable gases from the soot particles is accomplished at a temperature less than about 1100 °C.

53. The method of claim 51, wherein the separation of at least a portion of the condensable gases from the soot particles is accomplished at a temperature in the range of about 300 °C to about 900 °C.

54. The method of claim 51, wherein the gas/solid separations is conducted under conditions of optimal fullerene stability.

55. The method of claim 54, wherein conditions of optimal fullerene stability comprise conditions where consumption of fullerenes by soot particles or other species contained in the gas stream is minimized .

56. The method of claim 55, wherein the time-scale of gas/solid separation is small relative to the time-scale of fullerene consumption or embedding.

57. The method of claim 51, wherein the gas stream has a residence time of between about 10 msec and about 10 sec upstream of the separations process prior to separation.

58. The method of claim 51, wherein the gas stream has a residence time of between about 100 msec and about 2 sec upstream of the separations process prior to separation.

59. The method of claim 51, wherein the gas/solid separations process is a concentrator, producing a higher percentage gas effluent stream with respect to suspended soot, and a lower percentage gas effluent stream with respect to suspended soot.

60. The method of claim 51, wherein the gas/solids separations process is selected from the group consisting of filtration, electrostatic precipitation, electrostatic separation, and inertial separation.

61. The method of claim 60, wherein filtration is selected from the group consisting of sieve filtration, fiber filtration, and packed bed filtration.

62. The method of claim 60, wherein filtration is accomplished by the use of a ceramic particulate filter.

63. The method of claim 62, wherein the ceramic particulate filter contains a catalyst to promote thermal regeneration of the filter to remove collected soot.

64. The method of claim 63, wherein the ceramic particulate filter is selected from the group consisting of cordierite, silicon carbide, alumina, and alumina/silica compositions.

65. The method of claim 63, wherein the catalyst is a metal.

66. The method of claim 51, wherein the gas/solid separation is conducted at a time and location selected to provide soot particles that have an average particle size in the range of 0.1 μm – 100 μm.

67. The method of claim 51, wherein the gas/solid separation is conducted at a time and location selected to provide soot particles that are collectable on a filter having a mean effective pore size in the range of about 0.1 μm – 100 μm.

68. The method of claim 51, further comprising:

condensing at least a portion of the fullerenes in the condensable gases after separation of the condensable gases from the suspended soot.

69. The method of claim 68, wherein the condensed fullerenes form as suspended particles.

70. The method of claim 69, wherein the fullerenes condense by heterogeneous nucleation and/or homogeneous nucleation, in the gas stream which contains suspended seed particles.

71. The method of claim 70, wherein said seed particle comprises soot.

72. The method of claim 68, further comprising:

collecting the condensed fullerenes in a separations process.

73. The method of claim 72, wherein the percentage by weight of fullerenes to soot and other condensables in the collected condensed fullerenes is in the range of about 70% to 100%.

74. The method of claim 72, wherein the collected condensed fullerenes is enriched in fullerenes as compared to the fullerene content of the gas stream prior to separation of the suspended soot from the gas stream.

75. The method of claim 72, wherein the collected condensed fullerenes comprise about 10% to about 70% by weight fullerenes.

76. The method of claim 69, wherein the mean size of particles formed downstream of the gas solid separation device is in the range of 0.1 μm to 500 μm.

77. The method of claim 69, wherein the mean size of particles formed downstream of the gas solid separation device is in the range of 10 μm to 200 μm.

78. The method of claim 72, wherein the separations process comprises a gas/solid separations process.

79. The method of claim 78, wherein the gas/solids separations process is selected from the group consisting of filtration, electrostatic precipitation, inertial separation, and electrostatic separation.

80. The method of claim 79, wherein filtration is selected from the group consisting of sieve filtration, fiber filtration and packed bed filtration.

81. The method of claim 68, wherein the gas stream comprises nucleation sites to promote the condensation of fullerenes from the gas stream.

82. The method of claim 81, wherein the nucleation sites comprise soot particles, or other suspended particles having a particle size in the range of about 0.01 μm – 100 μm.

83. The method of claim 51, further comprising:

condensing at least a portion of a non-fullerene species in the condensable gases after separation of the condensable gases from the suspended soot; and

collecting the condensed non-fullerene species in a separations operation.

84. The method of claim 83, wherein the condensation is carried out at a temperature in the range of about negative 250 °C to about 600 °C.

85. The method of claim 51 or 68, wherein temperature is controlled by use of conductively cooled surfaces, and/or inert gases, and/or heat absorption by phase change..

86. The method claim 51 or 68, wherein residence time in the gas/solids separation process is controlled by addition of an inert gas.

87. The method of claim 20 or 72, wherein the collected condensed fullerenes are substantially free of polycyclic aromatic hydrocarbons (PAH).

88. The method of claim 20 or 72, wherein the collected condensed fullerenes are substantially free of soot.

89. The method of claim 87, wherein the polycyclic aromatic hydrocarbon (PAH) content of the condensable gases is reduced by reacting of the PAH with soot particles.

90. The method of claim 1 or 51, further comprising the step of:

during or after separation of the soot from the condensable gases of the effluent gas, introducing an oxidative species into the gas/solids separation process at temperatures that allow for oxidation of the collected soot.

91. A method for processing fullerenes, comprising the steps of:

burning a carbon-containing fuel in a flame under conditions effective to produce fullerenes and to generate an effluent gas comprising suspended soot particles and condensable gases, said condensable gases comprising fullerenes;

separating the condensable gases from the suspended soot particles using a gas/solid separations process to obtain condensable gases reduced in soot content; and

introducing the condensable gases comprising fullerenes into a subsequent location where further treatment or reaction of the fullerenes is conducted.

92. The method of claim 91, wherein the condensable gases comprising fullerenes are condensed to provide at least a portion of the fullerenes as suspended particles in the condensable gases, and the suspended particles are introduced into the subsequent location.

93. The method of claim 91, wherein the condensable gases comprising fullerenes comprise gaseous fullerenes, and the gas fullerenes are introduced into the subsequent location.

94. An apparatus for the processing of fullerenes comprising:

a gas effluent source capable of generating a gas effluent comprising suspended soot particles and condensable gases, said condensable gases comprising fullerenes;

an inlet conduit for directing a gaseous effluent to a first separation point;

a first gas/solid separation device located at the first separation point;

an outlet conduit for directing a gas effluent from the first separation point to a first collection point;

a collection device located at the first collection point; and

a temperature control for controlling the temperature of the gaseous effluent.

95. The apparatus of claim 94, wherein the temperature control comprises use of conductively cooled surfaces and/or inert gases and/or heat absorption by phase change.

96. The apparatus of claim 94, wherein the apparatus comprises a plurality of gas/solid separation devices and/or gas/solid collection devices.

97. The apparatus of claim 94, wherein the separation device is selected from the group consisting of filters, electrostatic precipitators, electrostatic separators, and inertial separators.

98. The apparatus of claim 97, wherein the filter comprises a sieve filter.

99. The apparatus of claim 97, wherein the filter comprises high temperature alumina beads.

100. The apparatus of claim 94, wherein the apparatus comprises a plurality of collection devices.

101. The apparatus of claim 94, wherein the collection device comprises a condensing surface.

102. The apparatus of claim 94, wherein the collection device is selected from the group consisting of of filters, electrostatic precipitators, electrostatic separators, and inertial separators.

103. The apparatus of claim 94, further comprising:

first and second gas/solid separation devices, each said device in flow communication with the inlet conduit;

means for directing the gases from the inlet conduit into the first or second gas/solid separations devices; and

first and second outlets for directing gas effluent from the first and second gas/solid separation devices, respectively.

104. The apparatus of claim 103, further comprising:

a first inlet port for introducing material into the first gas/solids separation device; and

a second inlet port for introducing material into the second gas/solids separation device.

105. An apparatus for the processing of fullerenes comprising:

means for generating and directing a gaseous effluent comprising suspended soot particles and condensable gases from a gaseous effluent source to a first collection point;

means for separating a first solid from the gaseous effluent at a first collection point;

means for directing the gas stream from the first collection point to a second collection point;

means for separating a second solid from the gaseous effluent at a second collection point; and

temperature control means for controlling the temperature of the gaseous effluent.

106. A method of cleaning a gas/solids separations device comprising a filter, comprising:

during or after separation of soot from a carrier gas and collection of the soot on a filter, contacting the filter with an oxidative species at a temperature that oxidizes the collected soot.

107. The method of claim 106, wherein the filter is a packed bed filter.

108. The method of claim 106, wherein the filter is a ceramic particulate filter.

109. The method of claim 106, wherein the filter comprises high temperature alumina particles.

110. The method of claim 106, wherein the oxidative species comprises air.

111. The method of claim 106, whereby an inert gas is added to the effluent gases of the thermal regeneration so as to reduce the temperature sufficiently that reaction of fullerenes collected downstream of the thermal regeneration does not occur.

112. The method of claim 106, whereby the effluent gases of the thermal regeneration are by-passed and do not contact fullerenes collected downstream so that reaction does not occur.

113. The method of claim 106, wherein the filter comprises a catalyst for the oxidation of soot.

114. The method of claim 106, wherein soot oxidation occurs concurrent with the separation of soot from the carrier gas.

115. The method of claim 114, wherein the oxidative species is introduced at or immediately prior to the soot filter.

116. A method of fullerene recovery from soot, comprising:

generating a gas stream comprising suspended soot particles and condensable gases, said condensable gases comprising gaseous fullerenes;

separating at least a portion of the condensable gases from the suspended soot particles using a filter;

during or after separation and collection of soot from the condensable gases on a filter, contacting the filter with an oxidative species at a temperature that oxidizes the collected soot; and

condensing and collecting fullerenes from the condensable gases downstream from the soot filter.

117. A method of processing fullerenes comprising the steps of:

generating a gas stream comprising suspended soot particles and condensable gases, said condensable gases comprising gaseous fullerenes;

condensing at least a portion of the condensable gases;

collecting the soot and condensed condensable gases at a collection location;

heating the collected soot and condensed condensable gases to sublime at least a fullerene species; and

condensing the sublimed fullerene species.

118. The method of claim 117, wherein the soot and condensed condensable gases are collected on a filter and are sublimed using heated inert gases.

119. The method of claim 117, wherein the soot and condensed condensable gases are collected on a filter and are sublimed in a combustion device operated in non-sooting conditions.

120. A method of processing fullerenes comprising the steps of:

generating a gas stream comprising suspended soot particles and condensable gases, said condensable gases comprising gaseous fullerenes,

separating at least a portion of the condensable gases from the suspended soot particles using a gas/solid separations process;

condensing at least a portion of the fullerenes in the condensable gases after separation of at least a portion of the condensable gases from soot; and

collecting the condensed fullerenes.

121. The method of claim 120, further comprising:

heating the collected fullerenes to sublime at least a fullerene species; and

condensing the sublimed fullerene species.